

SUSTAINABLE DESIGN AND REDESIGN OF BUILDINGS IN SLOVAKIA

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Summary

Sustainable development is one from discussed term today's time. Buildings and building design are with sustainable development much connected. Account on that Sustainable building is the subject of not only interest's scientists, but also all humane communities. This is beautiful concept into definition but covered strenuous mission. New buildings and theirs contribution for future generations wouldn't inhere only on reduction energy consumption, but also on reduction impact on environment. Buildings and theirs concept has constitute a means constitute a means reduction water requirement, high-class ground, heating energy, power, materials, building resources on reduction pollutant emissions into interior as well as into exterior. Existing buildings and planning houses should verify not only ground criteria and requirements of buildings, but also concept that is of in agreement with sustainable development. Building fund of every country consisted of a great quantities existing building with different purpose exploitation, with frequently different unfit environment interior quality, architectural construction and HVAC systems. Concept near their renovation oneself mostly manages request energy certificate without wide make provision for request sustainable development. Application of architectural concept that would abetted create sustainable building be in at designing and proposal new building inevitable. The paper shows other alternatives of renovation concept that includes the principles of sustainable development for purpose of green building design. This paper presents an actual state of primary school renovation, and its contribution to green design and renovation principles. Alternative concept of primary school renovation brings new perspective on renovation with effort for green concept of school building design and renovation. Currently used concepts for design and renovation of school buildings in Slovakia and other countries are presented in this paper.

Keywords: sustainable design, green building, school building

1 Introduction

There are quantity of existing buildings in many countries and in Slovakia that are renovated for the purpose of reduction of energy consumption and economic efficiency. This renovation is nearly always intended for saving of energy and material resources. The reduction of energy consumption brings also reduction of CO₂ emissions however it is only part of contribution included in sustainable development principles. Architectural and constructional design of renovation should follow sustainable concept as well as new

building design. Developing of new technologies, using of new progressive materials and building construction solutions leading to buildings quality not only in economical sense, but also in environmental and socio-cultural, represents potential for sustainable society development.

In 1987, the report of the World Commission on Environment and Development United Nations' Our Common Future "for the first time identified a requirement to ensure sustainable development. About 5 years later held a key United Nations Conference on Development in Rio de Janeiro, which was adopted Agenda 21. Agenda 21 defined the broad concept of sustainable construction and formulated the basic principles and objectives of sustainable construction. It covers the areas of process management, product quality and construction of objects, resource consumption (energy, materials, water and soil), construction impacts on sustainable urban development, environmental problems and social, cultural and economical issues. Defines the basic concept of sustainable building design, specifying its main problems and determines the resulting challenges for various stakeholders of the construction process, including investors and users. Proposal for sustainable buildings is directed to a process which is necessary to consider all the criteria of sustainable construction with a curved weighing their significance during all phases of the building lifecycle [1].

Sustainable development has become the search for such possible design and construction of buildings and human settlements, which have the smallest negative impact on the environment and to ensure the basic needs of human life, without compromising the needs of future generations, maintaining the diversity of nature and natural functions of ecosystems. The need for sustainable development is a known issue in the past two decades.

2 Sustainable building design

Strategies and principles of sustainable development is gaining interest and builders are crucial in the design, construction, use, renewal, but also the destruction of buildings. Building design, construction and operation have extensive direct and indirect impacts on the environment. Buildings use resources such as energy, water and raw materials, generate waste (construction, renovation and demolition) and emit potentially pollutant emissions. Building owners, designers and builders face a unique challenge to meet demands for new and renovated facilities that are accessible, secure, healthy, and productive while minimizing their impact on the environment. The idea of creating the sustainable buildings should be in the architectural and structural design and design of new buildings self-evident and should be not only in the need of energy efficiency but in the strong emphasis on the building quality from a sustainable perspective. In Slovakia there are no comprehensive and specifically defined concepts, which will be subject to asset building for sustainable development, but there is the possibility of advice and proposals to create green buildings. A series of alternatives for sustainable scenario, it is clear that we have a surprisingly wide margin to achieve the construction of high-level, without breaking the boundaries of the natural environment. Considering the current and actual economic challenges and economic problems, retrofitting an existing building can be more cost effective than construction of a new building. Designing major building renovations and retrofits for existing buildings to include sustainability initiatives reduces operation costs and environmental impacts, and can increase building resistibility and valuation.

2.1 Design solution of sustainable buildings

While the definition of sustainable building design is constantly changing, six fundamental keystones persist: Site Optimize / Potential Existing Structure; Energy Use Optimize; Protect and Conserve Water; Use Environmentally Preferable Products; Enhance Indoor Environmental Quality; Optimize Operational and Maintenance Practices. Creating sustainable buildings starts with proper site selection, including consideration of the reuse or rehabilitation of existing buildings. Building location, orientation, and landscaping in the building affect the local ecosystems, transportation solution and energy use. Incorporate sustainable principles in the project development process, whether it is a single building, school campus or airport. Solution for physical security is a critical issue in optimizing site design, including locations of access roads, parking, vehicle barriers, and lighting. Whether designing a new building or modernization and redesign an existing building, site design must integrate with sustainable design to achieve a successful project.

Sustainable design opportunities:

- Reduce heating, cooling, and lighting loads through climate-responsive design concept and conservation practices;
- Employ renewable energy sources such as day lighting, passive solar heating, photovoltaic, geothermal, and groundwater cooling;
- Specify efficient HVAC and lighting systems that consider part-load conditions and utility interface requirements;
- Optimize building performance by employing energy modelling programs and optimize system control strategies by using occupancy sensors CO₂ sensors and other air quality alarms;
- Monitor project performance through a policy of commissioning, metering, annual reporting, and periodic monitoring.

Water conservation must also be a key consideration in the reuse or renovation of an existing building. Reducing water consumption and protecting water quality are key objectives of sustainable design. To the maximum extent feasible, facilities should increase their dependence on water that is collected, used, purified, and reused on-site. The protection and conservation of water must be considered throughout the life of the building, and facility owners and developers must seek to reduce, control, and treat surface runoff; use water efficiently through low or ultra-low flow fixtures, elimination of leaks, water conserving; improve water quality; for example eliminate lead-bearing products in potable water; recover non-sewage and grey water for on-site use (such as irrigation); establish waste treatment and recycling centers. A sustainable building is constructed from materials that minimize environmental impacts such as global warming, resource depletion, and human toxicity. Environmentally preferable materials have a reduced effect on human health and the environment and contribute to improved worker safety and health, reduced liabilities, reduced disposal costs, and achievement of environmental goals. The indoor environmental quality of a building has a significant impact on occupant health, comfort, and productivity. Among other attributes, a sustainable building maximizes day lighting; has appropriate ventilation and moisture control; and avoids the use of materials with high-VOC emissions. Additionally, consider ventilation and filtration to mitigate chemical, biological, and radiological attack. Considering a building's operating and maintenance issues during the preliminary design phase of a facility will contribute to improved working environments, higher productivity, reduced energy and resource costs,

and prevented system failures. Encourage building operators and maintenance personnel to participate in the design and development phases to ensure optimal operations and maintenance of the building. Designers can specify materials and systems that simplify and reduce maintenance requirements; require less water, energy, and toxic chemicals and cleaners to maintain; and are cost-effective and reduce life-cycle costs. Additionally, design facilities to include meters in order to track the progress of sustainability initiatives, including reductions in energy and water use and waste generation, in the facility and on site [2].

3 Sustainable Schools

School sustainable design studies have demonstrated that students benefit significantly from attending schools where daylight, rather than traditional artificial lighting, was the principal source of internal lighting. According to the U. S. Department of Energy, design strategies and construction costs for sustainable designed schools do not show a significant cost increase over conventionally designed schools. Students who attend these schools benefit from day lighting, both in terms of increased performance and general health and well being. Sustainable schools are designed to help schools meet their energy needs without restriction the ability of future generations to meet their own needs. Sustainable school design concept includes efficient lighting and mechanical systems, environmentally friendly building materials, water conservation, and use of solar radiation. The buildings are positioned to maximize use solar energy. Sustainable school building is a good way to reduce environmental impact. So there is a possibility of awareness, knowledge, specific measures, but on the other hand, there is a financial budget, which fights many state schools in Slovakia. And under these circumstances, leadership and management of school buildings without contemplating the best sustainable building techniques, rather than the most economical procedure. Beautiful concept of sustainable construction and rehabilitation of buildings in its definition covered a tremendous challenge, creating the concept of benefit to future generations that would not consist only in reducing energy intensity, but also reduce environmental impacts.

Nowadays, many primary school buildings greatly devastated, with high energy consumption, with inadequate basic hygiene requirements. The biggest failures and deficiencies reported outside construction those buildings (roof, external cladding), often in buildings leak rainwater. The functionality of the border are building structures filling openings (windows, doors), shielding devices are usually broken or even completely missing. Thermal bridges caused in external cladding by low indoor surface temperature and the condensation of water vapour and beginning of mould. HVAC systems of buildings are also often in disrepair, or after the time of his technical and moral life. Schools could save up to 25 to 30% of brought energy targeted building modifications aimed at improving the thermal performance of buildings (thermal insulation, windows change), using technology with better effect, sensitive changes in operation and maintenance of schools. Nowadays is typically that around 1/3 of consumed energy in schools buildings is not efficiently used. This is particularly the use of old equipment with less efficiency (boilers) or equipment with the old and inefficient thermal insulation of heating distribution. It can be noted that schools operating power equipment with low efficiency, with the frequent need of repairs and missing or non-existent regulation, consume more energy than comparable school with a new, modern, more efficient

equipment and control. Responsibility for the efficient use of energy in school is usually school keeper, maintenance worker. Other employees, teachers, schoolchildren and students on the energy consumption in school are not interested. Their manners, however, many times unknowingly, it just leads to the not effective energy use and even waste of energy. Their greater involvement and awareness or change manners can significantly contribute to the economical use of energy in the school they visit. Just change of their manners and attitudes to energy use can reduce energy consumption in school up to 10% [3].

4 The current trend in renovation of schools in Slovakia

Renovation of primary schools buildings in Slovakia carried out to reduce energy consumption, coupled with a reduction of CO₂ emissions. It is one of the criteria of sustainable design proposal. The issues of sustainable criteria are the basis for the concept of sustainable design. The basis of the current renovation of buildings is reduction of the amount of energy need for heating and heat water preparing and price reduction in energy consumption for heating and heat water preparing.

Examples of such approach is the renovation of a primary school in Spišský Štvrtok consisted of exchange of the old windows and roofs, insulation, and a complete facade renovation, repairs refectories, gyms and school children's club. These are presented on (**Fig. 1**) and (**Fig. 2**). The school is located in three connected buildings, the original school (building 1962), gym (given into operation in 1989), a new extension with the school club and refectories (since 1998).



Fig. 1 School Renovation uses the contact insulation



Fig. 2 Renovation School, consisting of new windows

Similarly, the three primary school buildings in Sebechleby wad renovated in order to modernize and reduce energy consumption. This renovation consists of the exchange of windows with plastic profiles and insulating double-glazing, insulation envelope (**Fig. 3.**), new roof cladding, exchange of the socio-sanitary equipments and building wiring in the kitchen.



Fig. 3 Building school after the renovation

Although in the primary school on Polianska Street in Košice was exchanged the original 486 inconvenient wooden double windows by the windows with plastic frames and double glazing. The original glass concrete fillings were remained in the gym. Replacement of windows brings savings of at least 30% of heating costs, the annual heating costs nearly 40 thousand Euro. The school earmarked funds for the thermal insulation of the facades of individual pavilions. After the façade insulation, while the heat loss will decreased, but does not include the planned renovation of roof. In the next renovation step it is necessary to replace the heaters, whether regulation of thermal system. The concept of renovation follows the reduction of energy consumption but it is not intended to low-energy building, or passive or zero building. It is also likely that the renovation of roof cladding will tend to the idea of increasing of the roof thermal resistance and not to the sustainable concept. Pavilions will have a new roof with a more gross thermal insulation but they will not have sustainable green roof. Ventilation of the building is natural. Within the school kitchen is not installed air-distribution system with the benefit of heat recuperation. New windows and doors are plastic. There are not regarded the solution of quality natural materials. Rainwater abstraction is zero and rainwater from hard landscaping is not absorbed to storage tanks. Also is missing the winter garden with the possibility of solar profits. Area of drinking water saving and waste management is not incorporated in the concept of renovation, all at once even the possibilities of alternative energy sources, grass roofs, solar architecture, and other wide range of sustainable options in architectural design and operational solutions.

5 Trends in the world

The compact and sustainable building concept of primary schools uses the passive standard, with a dual function. Wood as a natural and renewable material is used to achieve comfort and energy savings, while providing a healthy indoor environment for users. The facade of the south tract-oriented schools is done with a wooden sandwich insulation thickness of 34 cm. The building is connected to a heat pump and solar collectors, with the

addition of photovoltaic panels to provide for electricity need. The need for heat is 25 kWh/m². South-oriented areas are protected against overheating by an outside shade on the facade as demonstrated by **Fig. 4**.



Fig. 4 South façade of the school in Switzerland

Design and construction of primary schools in passive standard in Frankfurt is an example of sustainable design. The classrooms, gym hall, kitchen and dining room is built from massive structures with the isolation; freeze screen avoids heat losses throw floor area. In the summer the building is protected from overheating by a massive structure, external shutters and with a night cooling system. Ventilation system with heat recovery is without additional heating. Heating is provided in pellet boiler. The photovoltaic system is located on the roof. Figure 5 illustrates an interior area, entrance hall and classrooms of primary school in Frankfurt, Germany.



Fig. 5 Layout and school interior in Frankfurt, Germany

Sustainable/green schools designed and operated in the United States have lower operating costs in order to save the funds and to improve student learning. Their carefully planned acoustics and enough daylight conditions bring easier and more convenient conditions for the education of students. The clean indoor air reduces the number of days of illness and absenteeism, and brings a healthy and prosperous future for students. Their innovative design allows for rich learning opportunities. Students, parents, teachers and community members require that their schools were built, operated and maintained as a sustainable and green. Example with sustainable design and green schools is shown in **Fig. 6**.



Fig. 6 Looking for school building Mabel Rush High School, USA

6 Conclusion

Renovation of school buildings in Slovakia, like the renovation of residential buildings is focused primarily on saving energy for heating, exchange of windows and doors and on insulation properties of envelope. In the present time the Slovak school buildings have the new plastic double-glazed windows and new contact insulating facades. The contribution to sustainable construction is very small or negligible. Addressing concept of school buildings renovation in Slovakia is alarming at this time. In the near future sustainable design would become a key aspect in design and renovation of school buildings. This new approach requires a change in the way of design, operation and renovation.

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